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MONTANA CLINICAL COMMUNICATION AND SURVEILLANCE REPORT

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MONTANA
CARDIOVASCULAR HEALTH AND DIABETES PROGRAMS

Montana Department of Public Health and Human Services
Chronic Disease Prevention and Health Promotion Program
Room C314, Cogswell Building - PO Box 202951
Helena, Montana 59620-2951

THE EFFECT OF PRE-PREGNANCY BODY MASS INDEX ON MATERNAL AND NEONATAL OUTCOMES

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Save the Date!

- 9th Annual Montana Cardiovascular Health Summit Conference, April 8-9
- Worksite Wellness Conference, April 26-27
- Commit to a Healthy Wyoming, May 5-6

BACKGROUND

Overweight and obesity are common among women of childbearing age. According to results from the 2002 National Survey of Family Growth, 25% of US women of childbearing age (20 to 44) were overweight and 23% were obese.[1] Analysis of the Behavioral Risk Factor Surveillance Survey (BRFSS) in Montana indicated that, between 2004 and 2008, 28% of Montana women of childbearing age (18 to 44) were overweight and 21% were obese, consistent with the US.

Compared to normal weight women, women who enter pregnancy overweight or obese are at higher risk for a number of adverse pregnancy outcomes, including: gestational diabetes, pregnancy induced hypertension and pre-eclampsia, and cesarean section. Compared to children of normal weight women, children born to women who are overweight or obese entering pregnancy are at higher risk for birth defects[2]; macrosomia; birth injury; obesity and metabolic syndrome in childhood[3]; and obesity and diabetes in adulthood. This report utilized Montana birth certificate records to investigate the effect of maternal pre-pregnancy body mass index (BMI) on selected maternal and neonatal birth outcomes.

METHODS

In 2008, Montana adopted the 2003 National Center for Health Statistics standard birth certificate which collects information on the mother's pre-pregnancy weight. Birth records

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from Montana vital statistics for the years 2008 and 2009 were utilized to ascertain live births among women in Montana. Montana residents with a singleton birth were included, whether or not the women had their delivery in state or out of state. We excluded births to women who delivered in state, but did not reside in state. In addition, births without maternal pre-pregnancy weight and height data (16%) were excluded.

Mother's pre-pregnancy body mass index (BMI) was calculated using the formula: (703* mother's pre-pregnancy weight)/mother's height in inches^2. Mother's pre-pregnancy BMI was then stratified into standard BMI categories. A BMI less than 18.5 kg/m^2 was considered underweight. Mother's pre-pregnancy weight was normal if it fell at a BMI between 18.5 and 24.99 kg/m^2. A BMI between 25 and 29.99 kg/m^2 was considered overweight, and a BMI greater than 30 kg/m^2 considered obese. In 2009, the Institute of Medicine (IOM) revised gestational weight gain guidelines (Table 1).[4] Recommended weight gain for an underweight woman is 28 to 40 lbs, normal weight woman is 25 to 35 lbs, overweight woman is 15 to 25 lbs, and an obese woman is 11 to 20 lbs. In our analyses, gestational weight gain under these recommendations was considered low and over these recommendations was considered excessive. Macrosomia was defined as birth weight greater than 4,000 grams. Low birth weight was defined as less than 2,500 grams.

Data analyses were conducted using SAS v9.1 (Cary, North Carolina). In each BMI group, means and standard deviations were calculated for age, pre-pregnancy BMI and pre-pregnancy weight. Mean age was compared across BMI group using analysis of variance. Frequency distributions were used to calculate the proportion of several maternal demographic variables, risk factors, delivery and birth outcomes within BMI groups. The chi-squared test for trend was used to assess differences in distributions between BMI categories. Multivariate logistic regression analysis was used to compute adjusted odds ratios, adjusting for the appropriate confounders.

RESULTS

Between 2008 and 2009, 18,811 (84%) live singleton births reported information on mother's height and pre-pregnancy weight. The majority of births were among women of normal BMI (Table 2). Twenty-five percent of births occurred among overweight women and 20% among obese women. The mother was underweight in 2% of births. Overweight and obese women were older, less likely to be married, and more likely to have smoked during pregnancy compared to normal weight women. Compared to normal weight women, overweight and obese women were significantly more likely to have had a previous birth, and significantly less likely to be breastfeeding at discharge (adjusted for age, cesarean section

Table 1. New Institute of Medicine recommendations for total weight gain during pregnancy by pre-pregnancy BMI[4]

Pre-pregnancy BMI class	BMI (kg/m^2)	Recommended weight gain (lbs)
Underweight	<18.5	28-40
Normal weight	18.5-24.9	25-35
Overweight	25.0-29.9	15-25
Obese (all classes)	≥30	11-20

Table 2. Demographic characteristics of mothers by pre-pregnancy body mass index (BMI) category, Montana, 2008-2009

	Underweight BMI <18.5kg/m² 2% (460/18811)	Normal Weight BMI 18.5-24.99 kg/m² 53% (9875/18811)	Overweight BMI 25-29.99 kg/m² 25% (4729/18811)	Obese BMI ≥30 kg/m² 20% (3747/18811)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Age (years)	24.5 (5.6)	26.7 (5.9)	27.0 (5.8)	27.5 (5.6)
Pre-pregnancy BMI (kg/m²)	16.9 (1.1)	21.9 (1.8)	27.2 (1.4)	35.3 (4.7)
Pre-pregnancy weight (lbs)	106.2 (12.0)	132.7 (14.8)	164.7 (16.0)	212.7 (34.3)
	% (n)	% (n)	% (n)	% (n)
Weight gain				
Low	32 (147)	23 (2288)	13 (631)	23 (857)
Recommended	43 (196)	38 (3788)	25 (1176)	24 (900)
Excessive	25 (117)	38 (3799)	62 (2922)	53 (1990)
Previous live birth	53 (246)	55 (5405)	61 (2864)	67 (2524)
Married during pregnancy	51 (235)	66 (6479)	63 (3002)	61 (3747)
Breastfeeding at discharge	80 (370)	84 (8285)	82 (3855)	77 (2889)
Education				
< High school	24 (107)	13 (1302)	13 (628)	14 (528)
High school	36 (164)	27 (2688)	30 (1395)	34 (1282)
Some college	18 (83)	20 (1947)	23 (1100)	25 (927)
College grad	22 (101)	40 (3879)	34 (1588)	27 (989)
Received WIC food during pregnancy	36 (165)	26 (2588)	31 (1473)	41 (1520)
Smoked during pregnancy	24 (112)	15 (1465)	17 (787)	21 (770)

and smoking status). Excessive gestational weight gain was more prevalent in overweight and obese women compared to normal weight and underweight women. Adjusting for parity and smoking status, overweight woman were nearly 3 times and obese women 2 times more likely to gain excessive weight during pregnancy compared to normal weight women. Interestingly, overweight women were 31% more likely and obese women were 110% more likely to have received WIC food during pregnancy compared to normal weight women (adjusting for age, education and marital status). Overweight and obese women who reported receiving WIC food during pregnancy were less likely to gain excessive weight than those not receiving WIC food.

Gestational diabetes was more prevalent among overweight and obese women, with overweight women 88% more likely and obese women 360% more likely to have gestational

Table 3. Maternal morbidities by pre-pregnancy BMI category, Montana, 2008-2009.

	Underweight	Normal Weight	Overweight	Obese
	% (n)	% (n)	% (n)	% (n)
Gestational diabetes (GDM)	2 (7)	2 (142)	3 (132)	7 (248)
Any hypertension during pregnancy	6 (26)	5 (505)	7 (343)	11 (413)
Pre-existing	--	--	--	2 (58)
Gestational (PIH, Pre-eclampsia)	1 (6)	3 (294)	4 (209)	8 (281)
Eclampsia	4 (18)	2 (185)	2 (112)	2 (88)

Table 4. Characteristics of labor and delivery methods by pre-pregnancy BMI category, Montana, 2008-2009.

	Underweight	Normal Weight	Overweight	Obese
	% (n)	% (n)	% (n)	% (n)
Cesarean section	22 (102)	23 (2232)	28 (1321)	39 (1475)
Induction of labor	20 (92)	25 (2469)	29 (1349)	30 (1136)

Table 5. Birth outcomes for infant by maternal pre-pregnancy BMI category, Montana, 2008-2009.

	Underweight	Normal Weight	Overweight	Obese
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Birth weight (grams)	3147 (513)	3305 (501)	3387 (520)	3420 (559)
	% (n)	% (n)	% (n)	% (n)
Macrosomia (birth weight >4000 grams)	3 (15)	7 (646)	10 (464)	12 (459)
Low birth weight (birth weight <2500 grams)	9 (40)	5 (497)	5 (211)	5 (188)

diabetes compared to normal weight women (after age adjustment) (Table 3). Adjusting for age and smoking status, overweight women were 43% more likely and obese women were 130% more likely to have hypertension during pregnancy compared to normal weight women. Though prevalence was low in all groups, underweight women were 2 times more likely to have eclampsia compared to normal weight women (adjusting for age and smoking status).

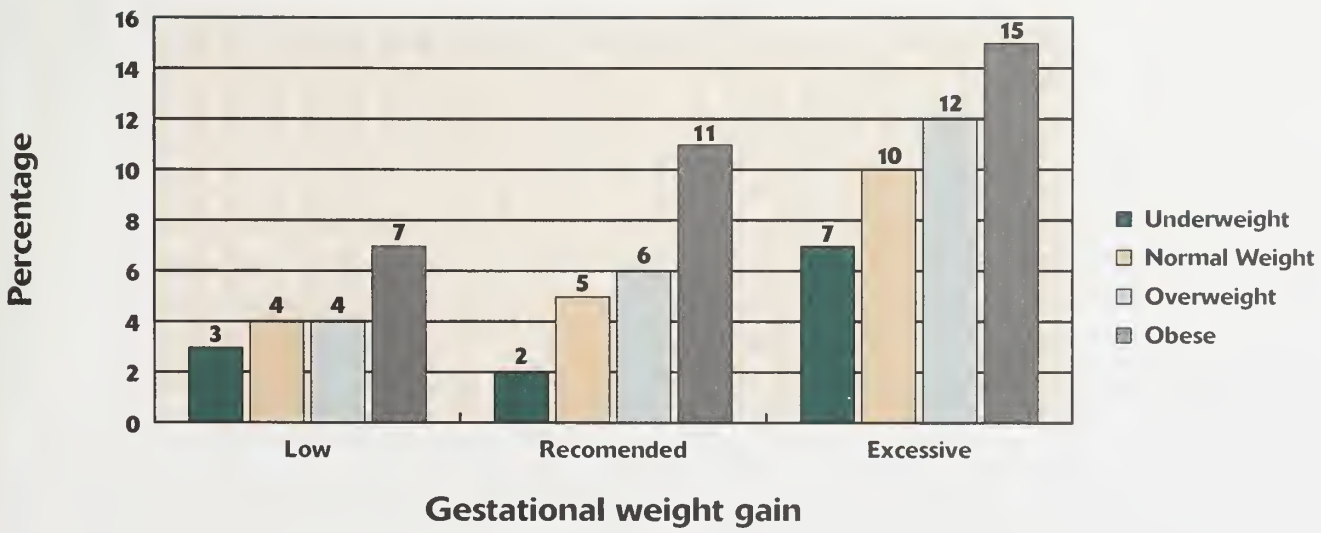
Delivery interventions were also more prevalent among overweight and obese women compared to normal weight women (Table 4). Obese women were 34% more likely to have labor induced and 120% more likely to have a cesarean section compared to normal weight women. Overweight women were 21% more likely to have labor induced and 30% more likely to have a cesarean section compared to normal weight women. Additionally, adjusting

for pre-pregnancy BMI category, women with excessive weight gain were 25% more likely to have a cesarean section compared to women who gained the recommended amount during pregnancy. Overweight women who gain excessive weight during pregnancy were 54% more likely and obese women who gained excessive weight were 160% more likely to have a cesarean section compared to normal weight women who gained the recommended amount of weight during pregnancy.

Babies born to overweight and obese women were bigger, on average, compared to babies born to normal weight women (Table 5). After adjusting for age, parity, diabetes, hypertension, weight gain and smoking status, an overweight woman was 28% more likely and an obese woman was 78% more likely to give birth to a macrosomic infant (birth weight greater that 4,000 grams) compared to normal weight women. Excessive gestational weight gain remained an important predictor of delivering a macrosomic infant. Compared to a normal weight woman who gained the recommended amount of weight, a normal weight woman who gained excessive weight was 2 times more likely, an overweight woman who gained excessive weight was 2.6 times more likely, and an obese woman who gained excessive weight was nearly 4 times more likely to deliver a macrosomic infant (Figure 1).

Babies born with low birth weight (less than 2,500 grams) were more prevalent among births to underweight women than women with higher BMIs. After adjusting for smoking status, weight gain and hypertension, underweight women were 46% more likely to give birth to a low birth weight baby compared to normal weight women. Additionally, an underweight woman with low gestational weight gain was 2.6 times more likely to give birth to a low birth weight baby compared to a normal weight woman who gained the recommended amount of weight. In this analysis, hypertension was the most important predictor of low birth weight; a woman with hypertension was over 4 times more likely to have a low birth weight baby compared to a woman without hypertension.

Figure 1. Percent of births resulting in a macrosomic infant, by maternal pre-pregnancy BMI category and gestational weight gain, Montana, 2008-2009.



DISCUSSION

Our findings suggest that pre-pregnancy overweight and obesity are strong risk factors for adverse pregnancy outcomes in Montana. Women entering pregnancy overweight or obese were at higher risk for gestational diabetes, hypertension in pregnancy, cesarean section and delivering a macrosomic infant. These women had higher rates of excessive weight gain compared to leaner women, increasing risk for cesarean delivery and macrosomia in their infants. The greater risk of cesarean section among women with pre-pregnancy overweight and obesity in Montana was similar to other US results, which found that overweight women were 46% more likely and obese women 100-189% more likely to have cesarean section compared to women with normal pre-pregnancy BMIs.[5] The risk for macrosomia among Montana women, combining maternal pre-pregnancy BMI and gestational weight gain was nearly identical to the risk found in another US study.[6]

Excessive weight gain in pregnancy increases the risk of postpartum weight retention in women of all BMI classes, increasing risk for future overweight and obesity. A study of the Danish National Birth Cohort found that 30-50% of women who gain excessive weight in pregnancy retained 10lbs postpartum.[7] Applying this finding to Montana, we estimate that 14-21% of Montana mothers are at risk for postpartum weight retention, increasing the likelihood that they will enter their next pregnancy at a higher BMI. Indeed, mothers in Montana who were overweight or obese entering pregnancy were more likely to have had a previous live birth; weight gained in their previous pregnancy may have contributed to a higher BMI entering subsequent pregnancy.

Preconception counseling is essential to avoid adverse pregnancy outcomes. Women should be encouraged to enter pregnancy at a healthy BMI; if women are overweight or obese, they should lose weight prior to pregnancy. However, since 50% of pregnancies are unplanned[8], all women of childbearing age should maintain a healthy weight. Gestational weight gain should be monitored at prenatal exams, and women counseled not to gain excessive weight. Intervention may be necessary if the rate of weight gain is on target to exceed recommendations. Postpartum, women should be encouraged to breast feed exclusively for 6 months. In addition to benefits to the infant, breastfeeding reduces postpartum weight retention. A recent Danish study found that in women who gained the recommended weight during pregnancy, exclusive breastfeeding for 6 months eliminated postpartum weight retention.[9] New mothers may need extra help losing weight gained during pregnancy; pediatricians may be important referral sources for these mothers, as they have frequent contact for Well Baby check-ups.

Another important partner in reducing BMI associated adverse pregnancy outcomes is the Montana WIC program. In 36% of births, the mother reported receiving WIC food during pregnancy; a large proportion of these mothers were overweight or obese prior to pregnancy. Case managers have ongoing contact with mothers throughout pregnancy and after delivery, creating several opportunities for intervention.

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SAVE THE DATE

MONTANA CARDIOVASCULAR HEALTH SUMMIT
APRIL 8-9, 2010

Hilton Garden Inn - Missoula, Montana

The Cardiovascular Health Program's annual professional conference will be held on Friday, April 9th, 2010 in Missoula, Montana at the Hilton Garden Inn. This year, a pre-conference Hypertension Workshop will be held on Thursday, April 8th, 2010 at the same location. For more information, contact Crystelle Fogle at (406) 947-2344 or e-mail cfogle@mt.gov.

WORKSITE WELLNESS CONFERENCE
APRIL 26-27, 2010

Holiday Inn - Bozeman, Montana

For more information, contact Linda Krantz at (406) 444-4105 or email lkrantz@mt.gov.

COMMIT TO A HEALTHY WYOMING
MAY 5-6, 2010

Little America Hotel and Resort - Cheyenne, Wyoming

A joint conference sponsored by several programs of the Wyoming Department of Health. For more information, contact Dave Ivester at (307) 777-3732 or email dave.ivester@health.wyo.gov.

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Montana Department of Public Health and Human Services
Chronic Disease Prevention and Health Promotion Program
Room C314, Cogswell Building
PO Box 202951
Helena, Montana 59620-2951

WHAT ARE THE MONTANA DIABETES PREVENTION AND CARDIOVASCULAR HEALTH PROGRAMS AND HOW CAN WE BE CONTACTED?

The Montana Diabetes Control and Cardiovascular Health Programs are funded through cooperative agreements with the Centers for Disease Control and Prevention and Health Promotion (1U58DP001977-01), the Division for Heart Disease and Stroke Prevention (5U50 DP000736-03) and through the Montana Department of Public Health and Human Services.

The mission of the Diabetes Control and Cardiovascular Health Programs is to reduce the burden of diabetes and cardiovascular disease among Montanans. Our web pages can be accessed at http://www.diabetes.mt.gov and http://montanacardiovascular.state.mt.us.

For further information please contact us at:

Section Manager
Mark Niebylski, PHD, MBA, MS
mniebylski@mt.gov

Epidemiologist - Diabetes
Taryn Hall, MPH
thall@mt.gov

Quality Improvement Coordinator
Diabetes Program
Chris Jacoby, BSN, RN
cjacoby@mt.gov

CVH Quality Improvement Coordinator
Marilyn McLaury, MS, RD
mmclaury@mt.gov

CVH Program Manager
Crystelle Fogle, MS, MBA, RD
cfogle@mt.gov

Epidemiologist - CVH
Carrie Oser, MPH
coser@mt.gov

Quality Improvement Coordinator
Diabetes Program
Elisabeth Mann, RN, CDE, CPT
elsmann2@yahoo.com

CVH Secondary Prevention Specialist
Michael McNamara, MS
mmcnamara@mt.gov

Diabetes Program Manager
Karl Vanderwood, BS, MPH
kvanderwood@mt.gov

Diabetes Education Coordinator
Marci Butcher, RD, CDE
marcibutcher@msn.com

Health Education Specialist
Linda Krantz
lkrantz@mt.gov

OR YOU MAY CALL:

Financial Specialist
Susan Day
Phone: 406-444-6677
sday@mt.gov

Quality Improvement Specialist, Cardiovascular Disease & Diabetes Prevention
Diane Arave, BS
darave2@mt.gov

Financial Specialist
Ava Griffenberg
Phone: 406-444-5508
agriffenberg@mt.gov

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